

**REMARKS**

Claims 1-3, 5, 7, 9 and 13-20 are all the claims presently pending in the application.

Independent claims 1-3, 5, 7, 9, and 13 have been amended to define more clearly and particularly the features of the claimed invention.

Claims 11 and 12 have been canceled without prejudice or disclaimer.

New claim 20 has been added to provide more varied protection for the present invention. No new matter has been added.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicants specifically state that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claims 1-3, 5, 7, 9, 11, and 13 stand rejected under 35 U.S.C. § 112, first paragraph.

With respect to the prior art rejections, claims 1 and 2 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Marchetto (U.S. Patent No. 5,666,378) in view of Aizawa, et al. (U.S. Publication No. 2002/0181574).

Claim 3 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Marchetto in view of Aizawa, in further view of Tomisato, et al. (U.S. Patent No. 6,862,316).

Claim 7 stands rejected under 35 U.S.C. §102(b) as being anticipated by Marchetto.

Claims 9 and 11-19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Marchetto in view of Aizawa, and further in view of Tomisato.

These rejections are respectfully traversed in the following discussion.

## **I. THE CLAIMED INVENTION**

As illustrated, for example, in independent claim 1, an equalizer for equalizing a detection signal obtained by detecting a reception signal at an oversampling rate, the reception signal periodically including known symbol patterns made up of at least one symbol, the equalizer including symbol pattern synchronizing means for reproducing symbol timing by detecting the symbol patterns based on the reception signal at the oversampling rate, equalizing means for acquiring an equalized signal by multiplying signals extracted from the reception signal at predetermined intervals of  $n$  samples and weights, symbol pattern generating means for generating a reference signal equal to the symbol patterns, error calculating means for acquiring an equalization error by subtracting the equalized signal from the reference signal; and weight updating means for updating the weights based on the detection signal and the equalization error at the timing of the symbol patterns.

Independent claims 3, 5, 7, and 9 define somewhat similar devices (and methods), according to the present invention.

Thus, the claimed invention provides an equalizer and equalization method as well as a receiver and reception method with little deterioration of the error rate characteristic even when a low oversampling rate or a short, known symbol pattern is used in order to overcome the disadvantages of symbol synchronization and demodulation processing at a high oversampling rate, which is the problem of the QAM system (e.g., see specification at page 7, first full paragraph). With the exemplary arrangement, carrying out selection diversity makes it possible to acquire excellent reception quality even in a fading propagation path environment and drastically reduce the amount of DSP signal processing (e.g., see specification at page 8, first full paragraph).

Thus, the present invention can effectively reduce an operation speed of an equalizer by, for example, combining PSI modulation (0005-0006) and MAM (0007).

Conventionally, it was necessary to use a high over sample rate for an equalized process. However, the present inventors recognized that, as long as a high over sample rate is adopted to the symbol synchronization, the operation speed can be reduced.

Applicants recognize that those skilled in the art may consider that the equalization accuracy to the propagation properties deteriorates by reducing the sample rate. However, Applicants have found that, by following quickly the variation of the propagation properties and following the properties more quickly by inserting one or more symbols and short symbol patterns at a short interval (for example, 16 symbols), the equalization accuracy to the propagation properties can be improved by reducing the sample rate. When the symbol patterns are received, it is necessary to reflect weights of the equalizer immediately and the present invention uses an algorithm having a quick response such as an LMS.

## **II. REJECTION UNDER 35 U.S.C. § 112, FIRST PARAGRAPH**

Claims 1-3, 5, 7, 9, 11, and 13 stand rejected under 35 U.S.C. § 112, first paragraph.

To expedite prosecution, Applicants have amended the claims in accordance with the Examiner's suggestion, thereby overcoming this rejection.

Therefore, the Examiner is requested to reconsider and withdraw this rejection.

## **III. THE PRIOR ART REJECTIONS**

A. Claims 1 and 2 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Marchetto in view of Aizawa.

To expedite prosecution, Applicants have amended Claim 1, for example, to recite that the symbol pattern synchronizing means is operated at an operation rate which differs from the equalizing means.

For example, independent claim 1 recites an equalizer for equalizing a detection signal, obtained by detecting a reception signal at an oversampling rate, the reception signal periodically including known symbol patterns made up of at least one symbol, the equalizer including:

*symbol pattern synchronizing means for reproducing symbol timing by detecting said symbol patterns based on said reception signal at the oversampling rate;*

*equalizing means for acquiring an equalized signal by multiplying signals extracted from said reception signal at predetermined intervals of n samples and weights;*

*symbol pattern generating means for generating a reference signal equal to said symbol patterns;*

*error calculating means for acquiring an equalization error by subtracting said equalized signal from said reference signal; and*

*weight updating means for updating said weights based on said detection signal and said equalization error at the timing of said symbol patterns (emphasis added).*

Thus, according to the claimed invention, the symbol pattern synchronizing means is operated at the oversampling rate.

In comparison, Marchetto discloses symbol timing block 126 in column 13, lines 6-35, and column 11, lines 44 - 54. However, Applicants submits that it is unclear how symbol timing error is determined based on difference in time, according to Marchetto.

Further, as set forth in Marchetto at column 11, line 29 - 43, the symbol timing block 126 interpolates between symbols. However, even if  $T$  is sample period ( $1/9600$ ) or symbol period ( $1/2400$ ), the interval between  $s(n)$  and  $s(n-T/2)$  does not correspond to an oversampling rate of reception signal (9600 samples/second).

Furthermore, as illustrated in Figures 3 and 5 of Marchetto, the synchronization block 132 is operated for 4 samples ( $2400/s$ ). That is, the symbol timing block 126 and synchronization block 132 do not conduct the reproduction of symbol timing by detecting symbol patterns based on the detection signal.

Further, in contrast to the claimed invention, the invention of Marchetto requires performing interpolation, which results in complex calculations by adding a hardware similar to an equalizer 203 of the present invention. Thus, the object of the present invention cannot be achieved by Marchetto.

In comparison, claim 1 recites the reproduction of symbol timing at the oversampling rate. Thus, claim 1 clearly does not entail processing in which the sample rate is changed such as by interpolation.

Accordingly, Applicants submit that Marchetto and Aizawa, either individually or in combination, do not disclose or suggest all of the features of claim 1.

On the other hand, claim 2 recites, *inter alia*, that “*said reception signal is demodulated with QAM, said symbol patterns consisting of not more than 4 symbols having maximum values in both of I and Q phases in the QAM symbol mapping, said weight updating means updates said weights using a Least Mean Square algorithm*” (emphasis added).

However, Applicants respectfully note that the Examiner does not appear to have considered all of the features of the claimed invention (e.g., see Office Action at page 7, paragraph b). For example, the Office Action does not consider the claimed feature of “*not more than 4 symbols that has maximum values in both of I and Q phases...*”, as recited in claim 2, and which clearly is not disclosed or suggested by Marchetto and Aizawa, either individually or in combination.

Thus, an adequate synchronization and smaller pilot symbol can be obtained by detecting maximum average power point (the pilot symbol is used for synchronization as well as training of the equalizer).

Moreover, the synchronization block 132 of Marchetto conducts synchronization detection using the correlation of pseudo-random sequence (e.g., see Marchetto at column 11, line 55 to column 12, line 10).

Therefore, according to Marchetto, it would be difficult to determine pseudo-noise when it adopts “*not more than 4 symbols*”, as recited in the claimed invention, because of the short length of the sequence.

Hence, the Examiner has not established that all of the features of the claimed invention are disclosed or suggested by the cited references, and therefore, has not established a *prima facie* case of obviousness with respect to claim 2.

For the foregoing reasons, Applicants submit that Marchetto and Aizawa, either individually or in combination, do not disclose or suggest all of the features of claims 1 and 2. Therefore, the Examiner is requested to reconsider and withdraw this rejection and to permit these claims to pass to immediate allowance.

**B.** Claim 3 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Marchetto in view of Aizawa, in further view of Tomisato.

Applicants submit that claim 3 is patentable for somewhat similar reasons as claim 1.

Moreover, Applicants submit that Tomisato does not make up for the deficiencies of Marchetto and Aizawa.

For example, Tomisato relates to an adaptive array antenna. In Tomisato, it is necessary to synthesize reception signals from plural antennas to conduct beam-forming. According to the invention of Tomisato, when selecting one antenna, the function of the array antenna is adversely affected.

For the foregoing reasons, Applicants submit that Marchetto, Aizawa, and Tomisato, either individually or in combination, do not disclose or suggest all of the features of the

claimed invention. Therefore, the Examiner is requested to reconsider and withdraw this rejection and to permit this claim to pass to immediate allowance.

C. Claim 7 stands rejected under 35 U.S.C. §102(b) as being anticipated by Marchetto.

To expedite prosecution, claim 7 is amended to depend from claim 3.

Applicants submit that claim 7 is patentable over Marchetto by virtue of its dependency from claims 1 and 3, as well as for the additional features recited therein.

For example, claim 7 recites, *inter alia*, that “*equalization processing is carried out based on weights updated when the synchronization position of said detection signal is detected, whereas equalization processing is carried out without weight updating when the synchronization position of said detection signal is not detected.*”

As mentioned above, according to the claimed invention, the symbol pattern synchronizing means is operated at the oversampling rate.

In comparison, Marchetto discloses symbol timing block 126 in column 13, lines 6-35, and column 11, lines 44 - 54. However, Applicants submits that it is unclear how symbol timing error is determined based on difference in time, according to Marchetto.

Further, as set forth in Marchetto at column 11, line 29 - 43, the symbol timing block 126 interpolates between symbols. However, even if  $T$  is sample period ( $1/9600$ ) or symbol period ( $1/2400$ ), the interval between  $s(n)$  and  $s(n-T/2)$  does not correspond to an oversampling rate of reception signal (9600 samples/second).

Furthermore, as illustrated in Figures 3 and 5 of Marchetto, the synchronization block 132 is operated for 4 samples (2400/s). That is, the symbol timing block 126 and synchronization block 132 do not conduct the reproduction of symbol timing by detecting symbol patterns based on the detection signal.

Further, in contrast to the claimed invention, the invention of Marchetto requires performing interpolation, which results in complex calculations by adding a hardware similar to an equalizer 203 of the present invention. Thus, the object of the present invention cannot be achieved by Marchetto.

For the foregoing reasons, Applicants submit that Marchetto does not disclose or suggest all of the features of the claimed invention. Therefore, the Examiner is requested to reconsider and withdraw this rejection and to permit this claim to pass to immediate allowance.

**D.** Claims 9 and 11-19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Marchetto in view of Aizawa, and further in view of Tomisato.

While Applicants believe that all of the claims are patentable over the prior art of record, to expedite prosecution, claims 11 and 12 are canceled without prejudice or disclaimer to the filing a divisional application directed to the subject matter of these claims.

With respect to claims 9 and 13-19, Applicants respectfully traverse this rejection, for at least the following reasons.

Applicants submit that claims 9 and 13-19 are patentable over Marchetto, Aizawa, and Tomisato, either individually or in combination, for somewhat similar reasons as claim 1.

For example, claim 9 somewhat similarly recites a reception method for carrying out diversity receiver for a reception signal at an oversampling rate, the reception signal periodically including known symbol patterns made up of at least one symbol, the method including:

*a reception step of receiving said reception signal by a plurality of antennas;*  
*a detecting step of carrying out quadrature detection on received signals from said corresponding antennas using a plurality of detecting means;*



*a plurality of equalizing steps of carrying out equalization using said reception signal at the oversampling rate;*  
*a selecting step of selecting processing results obtained by said plurality of equalizing steps corresponding to said plurality of detecting means; and*  
*a deciding step of deciding data based on said selected processing result;*  
*wherein each of said plurality of equalizing steps comprises:*  
*a step of equalizing a detection signal obtained by detecting a reception signal at the oversampling rate, said reception signal periodically including known symbol patterns made up of at least one symbol; and*  
*a step of detecting a symbol synchronization position by detecting said symbol patterns based on said reception signals at the oversampling rate,*  
*wherein equalization processing is carried out based on weights updated when the synchronization position of said detection signal is detected, whereas equalization processing is carried out without weight updating when the synchronization position of said detection signal is not detected (emphasis added).*

On the other hand, independent claim 13 somewhat similarly recites a reception method for carrying out diversity receiver for a reception signal with periodically inserted known symbol patterns made up of at least one symbol, the method including:

*a step of receiving said reception signal by a plurality of antennas;*  
*a step of carrying out quadrature detection on received signals from said corresponding antennas using a plurality of detecting means;*  
*a step of detecting a symbol synchronization position by detecting said symbol pattern based on said reception signals output from said plurality of detecting means;*  
*wherein equalization processing is carried out based on weights respectively updated when the synchronization position of said detection signal is detected, whereas equalization processing is carried out without updating of respective weights and the respective outputs of equalization processing are combined with each other when the synchronization position of said detection signal is not detected (emphasis added).*

Applicants submit that claims 14-19 are patentable over the cited references by virtue of their dependency from claim 1, as well as for the additional feature recited therein.

For the foregoing reasons, Applicants submit that Marchetto, Aizawa, and Tomisato, either individually or in combination, do not disclose or suggest all of the features of the claimed invention. Therefore, the Examiner is requested to reconsider and withdraw this rejection and to permit claims 9 and 13-19 to pass to immediate allowance.

#### **IV. NEW CLAIM**

New claim 20 has been added to define more clearly and particularly the features of the present invention.

Applicants submit that claim 20 is patentable over the cited references, either individually or in combination, for at least somewhat similar reasons as those set forth above.

#### **V. FORMAL MATTERS**

##### **IDS Form PTO 1449**

Applicant respectfully notes that the IDS filed on May 6, 2002, properly included a legible copy of "Simplified Decision Feedback Equalizer Using Interpolation" (Sanbe, et al., Technical Report of Institute of Electronics, Information and Communication Engineers (CS91-22 (1991-06) pp. 37-43, as shown by the date-stamped post card indicating that the IDS and four (4) documents were filed on May 6, 2002.

However, for the Examiner's convenience, a duplicate copy of "Simplified Decision Feedback Equalizer Using Interpolation" is submitted herewith.

The Examiner is requested to consider and initial page 2 of the PTO-1449 Form for the IDS filed on May 6, 2002. For the Examiner's convenience, a duplicate copy of the PTO-1449 Form also is resubmitted herewith.

**Specification**

Applicants amend the specification and Abstract to correct errors, in accordance with the Examiner's suggestions.

Therefore, the Examiner is requested to reconsider and withdraw these objections.

**VI. CONCLUSION**

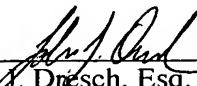
In view of the foregoing, Applicants submit that claims 1-3, 5, 7, 9 and 11-19, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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